

Cost and Management

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OPERATIONS RESEARCH

By P. J. ROBINSON

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Mr. Robinson is Co-Ordinator in charge of Marketing Research for Imperial Oil Limited. After graduating from McGill University in Mechanical and Industrial Engineering (B.Eng.), and from the Massachusetts Institute of Technology in New Product Development and Appraisal, Mr. Robinson received training for his Master's Degree at Harvard Graduate School of Business Administration. He then joined the Economics Department of Imperial Oil. Mr. Robinson has lectured widely on Operations Research and allied subjects. This paper formed part of the technical sessions at the 33rd Annual Cost and Management Conference of S.I.C.A. last July.

FINANCING AND TAXATION IN THE CANADIAN OIL INDUSTRY

By T. O. MEGAS

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A Registered Member of the S.I.C.A., Mr. Megas was the only Canadian to participate in the 8th Annual Conference of Accountants, at University of Tulsa in April 1954. This paper was presented to that conference. Mr. Megas, who is Treasurer of Pacific Petroleum Limited, Calgary, is a Charter Member of the Calgary Chapter of the Alberta S.I.C.A., Past President of the Edmonton Chapter, and also Immediate Past President of the Petroleum Accountants' Society of Western Canada.

COST REDUCTION IN THE LIMELIGHT

By GEORGE MOLLER

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Dr. Moller, who is Treasurer and Comptroller of Robertson-Irwin Limited, Hamilton, is a Registered Member of the Ontario Society of Industrial and Cost Accountants and Chairman of the Legislation Committee of the S.I.C.A. of Canada. He received the degree Doctor Juris from the University of Prague, where he had studied Political Science and Law. He came to Canada in 1936, joined the firm of George A. Touche and Company, and in 1945 was admitted to membership in the Institute of Chartered Accountants of Ontario. He is a regular contributor to Cost and Management, his most recent article being Management Accounting for Small Enterprises, which appeared in the May 1954 issue.

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Editorial Comment . . .

HOW IS YOUR ABILITY TO PAY?

Accountants are going to hear more about the ability of their company to pay. While it might be premature, or even inaccurate to talk about a recession, certainly profit margins are narrowing. Intense competition, idle capacity, irregular operations, have all contributed to a leaner income. It is also extremely doubtful if increased costs can continue to be passed on to the consumer.

In Canada, particularly, foreign competition has diminished our volume exports and as a result some industrial fields, notably textile, are in a depressed condition.

This situation has quite naturally brought about a reluctance on the part of management to consider further increases in wages and salaries, or at least increases in the order of those given in the early part of the post war years. Many companies and whole industrial groups are pleading inability to pay.

This statement may be thought of as purely academic, as something to be taken at face value and dependable, to the degree that one may place dependence on the source. However, through the usual counter-checks that obtain in such a situation, a verbal statement of non-ability to pay is well nigh useless.

A great many corporations will not want to divulge financial information in part or wholly. Private corporations can still keep their position reasonably well guarded. However, where any large number of stockholders are concerned in a public company, Balance Sheet and Profit and Loss figures are fairly available. For many companies then, a refusal to show these basic documents is probably an empty gesture.

It might be interesting to consider what is involved when a company pleads inability to pay and decides to back up its claims.

A particular company recently offered a statement signed by its public auditors demonstrating its poor position. As may be expected, this was not found acceptable at the bargaining table.

If basic information through publishing of the Balance Sheet and Profit and Loss statement is available by one means or another, how effective is this in demonstrating a poor position?

A recent study made on the reading habits of stockholders, produced the rather interesting figure that 65.8% read the income statement. Some 26.5% read the balance sheet and .6% understood the working capital position. This does not demonstrate any very great understanding of the significant facts of financial statements, even by people who have a share interest. It does demonstrate that most laymen do not understand the nature of profits, working capital, surplus and the other means of determining financial health and the ability to pay more.

EDITORIAL

Outside of the problem of presentation of financial information in traditional form, there is then a problem of understanding, or perhaps communications, as the industrial psychologist would prefer. The balance sheet and profit and loss statement would appear to have a limited use in collective bargaining.

Along with individual company practice or policy, this becomes a matter of first order business to the accounting profession. What can, or should be done in demonstrating ability to pay?

A suggested list of questions might be:

What are business profits before and after taxes?

What benefits did the ownership interest receive?

What profits did the employees receive?

What profits should be retained for expansion and general economic health?

How does the company's financial position compare with other companies in the same line of business?

This last point would certainly be considered by Unions in their collective bargaining. Recently at a conference of Canadian Unions, it was suggested that ability to pay be considered on the basis of the financial state of an industry group, rather than on a single corporation in the group.

Other questions that might be thought about more are — what is future business like in terms of sales volume and costs?

There is food for thought in this problem for the accounting profession. Obviously no set solution presents itself. Company policy and the traditional sense of security on final profit information cannot be lightly tossed around by the accountant. He is primarily a servant of the company for which he works, and must respect its procedures and wishes. However, he must be alive to changing conditions and, at least, be prepared with the answers when required.

OBITUARY

P. J. Carroll, R.I.A., a Charter Member and Member of the Council of the Society of Industrial and Cost Accountants of Nova Scotia, died at Sydney, N.S., on Saturday, October 9th, following a short illness.

P. J. Carroll, known better to his friends as "Paddy", came to this country from Ireland as a young man. He was associated all his business life with the Dominion Coal Company Limited, and was Controller of that company and its subsidiaries at the time of his death.

An indefatigable worker for the Nova Scotia Society, Mr. Carroll was reputed never to have missed a Council meeting, despite the fact that he lived some 200 miles from the centre where the meetings were held. He took a great interest in the Educational programme of the Society.

His death is a great loss to the Society and particularly to the S.I.C.A. of Nova Scotia.

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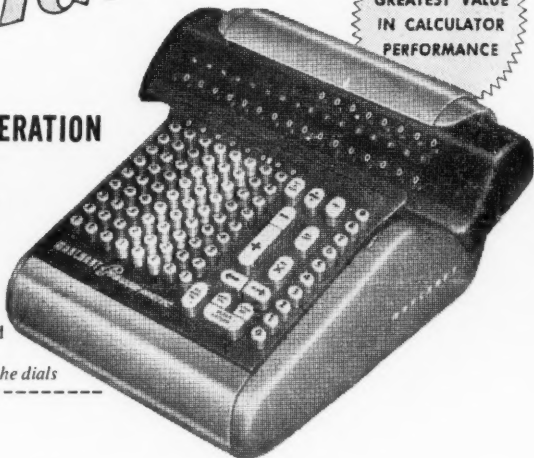
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C & M Round-Up . . .

By N. R. BARFOOT, R.I.A.

Population Changes:

Growth rate in Canada around $2\frac{1}{2}\%$ per annum; a faster rate than the U.S.

Birth rate is estimated at 28.2 per 1,000 of population.

Death rate has continued to fall and is 8.7 per 1,000 of population at the moment. This is three-quarters of the rate in the twenties.

Marriage rate is around 9 per 1,000 of population.

The 1941 census showed the under ten years of age group to be less than the 1931 figure. The 1951 census returns show a very large increase.

The increase in the number of old people reflects the falling death rate, for example, in 1931 the 60 plus group represented 8.4% of the population, in 1953, 11.3%.

The active working age group (15 to 59) which, generally speaking, must provide for the needs of the whole population, increased by only 12% between the last two censuses, as compared with an increase of 19% for the whole population, and in 1951 made up 58% of the population, as against 62% in 1941.

People are marrying earlier — in 1951 64% of the population 15 and over was married, as against 57% in 1941 and 54% in 1911.

In 1951, in the 20 to 24 age group 25% of the males and 51% of the females were married, as against 16% of the males and 39% of the females ten years earlier.

What About Diversification of Products?

There is a trend to diversification of product lines on the part of many companies. New markets raise the hopes of a better profit position and are an economic hedge on the future.

In two ways this is accomplished —

1. Mergers to acquire new markets.
2. Addition of new lines to broaden the sales field.

A long term diversification programme may lead to a vastly different market which may be entirely desirable.

A rounding out of existing lines is an alternative to complete diversification.

Benefits may be — reduction in the cost of distribution. Tax minimization can be another incentive — capital gains are inducements. However, the primary motive is a strengthening of profit position and a preventative to the feast or famine cycles of certain restricted lines of goods.

Questions to be asked before diversification, are:

Does the new product lend itself to manufacture with our present facilities?

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Can the present overhead, supervisory and technical handle the new line?

Will the new product be a fringe or solid contribution to profit?

Can it be distributed through our present sales or outlet channels?

Does the new line compete with those of our present customers?

Will new capital be necessary?

Have we accurately calculated selling and cost price, if so, is the margin sufficient?

Those Medical Plans

Labour Gazette — August

2.4 million people are covered in Canada today.

In 1946 only 200,000.

Some 14 plans are in operation.

Over 1 million persons are entitled to a fairly comprehensive range of benefits, including medical, surgical and obstetrical care.

Twenty-seven millions was paid out in 1953 on behalf of the members.

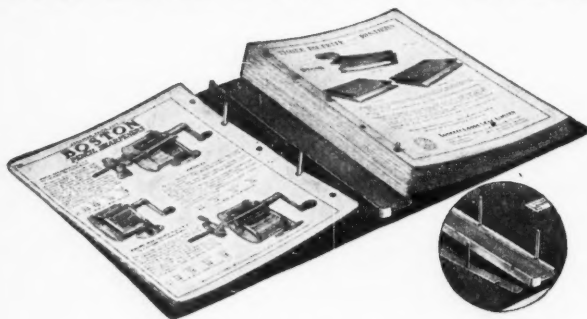
44 percent of every dollar goes to physician.

30 percent goes to surgeon.

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Personals . . .

S. A. Norman, C.P.A., R.I.A., was recently elected President of the Certified Public Accountants' Association of Ontario. A member of the Toronto Chapter of S.I.C.A., Mr. Norman is a partner in the firm of Norman, Sheppard, Elliot & Company, Toronto. His home is in West Hill, Ontario.

Dominique Bertrand, C.G.A., R.I.A., of the Quebec Chapter, has been elected National Chairman of the Canadian Shoe Manufacturers' Association. He is President of A. Laliberte Limited, in Quebec. Mr. Bertrand is a member of Council of the S.I.C.A. of Quebec and of the Canadian Board of Directors of the Society.

R. V. McLaughlin, R.I.A., has been appointed Cost Accountant for Philips Industries at Leaside, Ont. Mr. McLaughlin, who was formerly with the Massey-Harris-Ferguson Company in Toronto, is a member of the Ontario Council of the Society and of the Co-Ordinating Educational Committee. He is also Honourary Secretary of the S.I.C.A. of Ontario.

A. J. Newmark, R.I.A., has joined Philips Industries Limited, Winnipeg, as Credit and Office Manager. Mr. Newmark has previously been with the Sterling Fruit branch of Dominion Fruit Limited for 27 years. He is a member of the Winnipeg Chapter.

G. E. Owen, R.I.A., has been appointed General Manager of Dietrich-Collins Equipment Limited in Vancouver. A member of the Vancouver Chapter, Mr. Owen was previously employed with the Vancouver Iron Works Limited.

W. Nobbs, C.A., R.I.A., has been appointed Auditor for the Board of Public Utility Commissioners in Edmonton, Alta. He was a member of the Calgary Chapter.

E. R. Birkett, R.I.A., a member of the Kingston Chapter and formerly its Secretary, has enrolled in the Harvard Graduate School of Economics, Cambridge, Massachusetts.

Yoshio Iwamoto, a student member of the Toronto Chapter, is studying this year at the University of Michigan, Ann Arbor, Mich.

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Mr. Marcel Caron, Managing Director, Co-operative Credit Society of Manitoba Limited, 304 New Hargrave Building, Winnipeg, writes:

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Books in Review . . .

by MARY DRAPER, B.A.

Among the recent books of interest to accountants and business executives which we have received are the following:

COST ACCOUNTING **Text, Problems, Cases**

By Clarence B. Nickerson, McGraw-Hill Publishing Company, New York, Toronto 1954. \$6.50.

This latest addition to McGraw-Hill's series of Harvard Problem Books uses the case method to teach students the basic principles of Cost Accounting. Its author, Professor C. B. Nickerson, of the Graduate School of Business Administration, Harvard University, states that his main objectives are "to provide material for study and discussion which will help the student develop a basic understanding of cost accounting that will enable him to make effective use of such accounting in business." He emphasizes in particular the need for the student to be able to grapple with facts in analysis of business problems, to reason in business situations and to make business decisions. The book covers standard costs, budgetary control, burden, government accounting, inventory valuation and much more. A new text made distinctive by its almost complete reliance on the case method.

AN INTRODUCTION TO COST ACCOUNTANCY

By R. Warwick Dobson, C.A., F.C.W.A. Gee and Company (Publishers) Limited, London EC2. Vols. II and III, 1954. \$3.50.

A new study from England; the second and third volumes of this work by R. W. Dobson have just been published. The first volume of the trilogy "Costing and Cost Control" was on the market last year. Volume II, "The Elements of Cost Accounting" has just reached our desk, and the publishers tell us that Volume III is now ready. This last volume will be titled "Cost Recording and Presentation". Present volume — the second — deals with historical standard and marginal costing techniques and with uniform costing, budgetary control and cost improvement, and classifying costs for control.

ACCOUNTING SYSTEMS

By Cecil Gillespie. Prentice-Hall, New York, 1951. Bp. 800. \$9.00.

Accounting Systems, Procedures and Methods is the full title of this 800-page book. Liberally sprinkled with charts, illustrations and diagrams, it will serve as a useful reference to all who are concerned with accounting and particularly those who must install or organize accounting operations and procedures.

The material is organized as follows: How to make the survey; Basic plans of summarizing; Internal check and accounting control; Accounting for small businesses; methods; systems and procedures; Reports and manuals; Punched card tabulating. Each of these is broken down into a number of chapters and the whole is introduced by a general chapter on the field of systems and procedures work.

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RESEARCH REPORTS

Realistic Depreciation Policy

A Research Report of the Machinery and Allied Products Institute, 1954.
\$6.00.

An analysis of the course of capital consumption in relation to asset life. Development of tax depreciation policy and its effects. This book is aimed particularly at the capital goods and allied equipment industry, but should prove to be of value to all accountants and others interested in a detailed study of depreciation and policy problems connected therewith.

Centralization vs. Decentralization In Organizing the Controller's Office

A research report prepared for the Controllershship Foundation by H. A. Simon, Harold Guetzkow, George Kozmetsky and Gordon Tyndall, all of the Graduate School of Industrial Administration, Carnegie Institute of Technology.

This 105-page book, the result of long study by the Committee comprised of its four authors, is available from the Controllers Institute. Price is \$6.00 (\$4.00 to members of the Institute).

Employee Remuneration and Incentives

A report of the Research and Technical Committee of the Institute of Cost and Works Accountants (Great Britain) on a timely topic. The actual writing of the book was done by W. L. Withers, F.C.W.A., and the result is a 70-page illustrated report covering the underlying principles, various methods of application and the factors influencing remuneration and incentives. It is priced in England at 7s 6d.

Management In Balance

The New Zealand Society of Accountants is the publisher of this informative booklet on Management Accounting — a subject very much in the foreground today. The booklet is actually a reprinting of an excellent lecture on the subject given by R. D. Greenwood as the 33rd Annual Research Lecture of the New Zealand Society.

Capital Equipment Replacement

This is Special Report No. 1 of the American Management Association. It is an adaptation of the material presented at the A.M.A. Special Conference on Capital Equipment Replacement, held in May 1954 in New York. Titles of the papers are: "Operating and Managerial Factors", "Economic and Financial Factors", "An Over-all System of Capital Controls", "The Investor's Method of Computing Rate of Return as Applied to Replacement Valuation", "A Scientific Formula for Solving Replacement Problems", "The Competitive Demand System of Capital Budget Preparation", "Lease or Purchase? — Alternate Methods of Industrial Financing" and "A Comprehensive System of Performance Reports". This collection of articles makes up a 90-page booklet of interesting and informative discussion on an important management problem. The seven authors give the reader the benefit of many years' research undertaken by the companies they represent.

Operations Research . . .

By P. J. ROBINSON,
Co-ordinator, Market Research,
Imperial Oil Co. Ltd.

This paper on the recently developed methods of Operations Research formed part of the technical sessions of the 33rd Annual Cost and Management Conference last July. Mr. Robinson attempts to define Operations Research — "It represents the application of many special techniques and skills, plus imagination, to finding the most desirable solution to a problem, and the probable consequences of any alternate course of action". He illustrates this scientific approach to business problems with reference to particular instances and methods, with some mention of the role of electronics in Operations Research.

IN SOME respects Operations Research grew like Topsy. World War II saw its birth as a result of military strategists calling on leading scientists, mathematicians, physicists and others to study the problems of warfare from an advanced analytical point of view. These specialists applied approaches and techniques previously unknown in warfare and were able to contribute in a major way to the eventual successful outcome by indicating to the allied leaders the probable consequences of taking any one of a number of alternate courses of action.

Shortly after the war, some forward looking thinkers in business began to test the potentialities of Operations Research, or OR as it has become familiarly known, on problems in the field of business and commerce. Operations Research Analysts and Consultants drew freely on the experiences and successes of wartime developments; in addition to developing and testing new techniques borrowed from various sciences and mathematics.

The term "Operations Research" appears with increasing frequency in many of today's business and news publications. This comparatively new field of scientific endeavour is suffering currently from numerous growing pains. Not the least of these is the problem of defining the term itself. Since universal agreement on this is lacking even amongst its practitioners, numerous misunderstandings and misconceptions are bound to arise in the minds of management and other professional people.

Generally speaking, Operations Research is a technical way of naming "horse sense with a scientific flavour". As such, it represents the application of many special techniques and skills, plus imagination to finding the most desirable solution to a problem, and the probable consequences of any alternate course of action. This definition is crude, but, for lack of a better one for introductory purposes, we will use it and try to refine and expand it as we go along.

To illustrate one way in which Operations Research might work, let us consider the general approach taken to a jigsaw puzzle type of problem. It is first necessary to know that the average Operations Research Analyst has a highly scientific training and the scientist's approach to a problem. He will always wish to find out what has been

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done by others in the field before commencing, so as to avoid duplication of effort, and then will begin "at the grass roots". He will want to know how and why a thing is being done and what, if any, cause and effect relationships are known. He will attempt to form a basic working hypothesis or theory and then from knowledge of the problem and historical information, test and develop his approach.

In the case of a jigsaw assortment of information, an unscientific approach would be simply to sit down with all the pieces and start by trying to fit them together in any pattern possible — taking the first two pieces at hand and so on. This can be quite frustrating, time-consuming and unrewarding. Failure to get results may lead to abandoning any form of methodical approach in favour of a "seat of the pants" type of operation in which judgment, unaided by assembled data and analyses, suggests the best alternative based on experience and possibly superficial observations. This may or may not come close to providing a worthwhile picture as a basis for decisions. All too often a misleading or distorted result can lead to trouble and reverses. In contrast, a routine statistical approach to the problem might result in a bringing together all pieces of a like nature and proceeding to develop some test to discover whether any pattern exists. Unfortunately, many business problems are too complex to be solved easily by applying such techniques to available information. To obtain any worthwhile picture may require special techniques or a basically different viewpoint.

Often decisions are made or action taken on what appears to be a very profitable basis for one part of a business when actually, in the overall picture, this may be quite far removed from the optimum or ideal approach which could be taken. This lack of regard for the impact of decisions in one phase of the business in relation to others is referred to as "sub-optimization". Successful Operations Research cannot be undertaken unless any chain reaction of circumstances resulting from making decisions is fully explored and evaluated. Only in this way can the best interests of any company as a whole be considered.

Clearly, for any analytical approach to succeed it must embrace all aspects of an operation and be capable of handling all known significant factors with the utmost flexibility. We need both a broad gauge tool and also the power to push through vast amounts of information. This means that the methods employed must be so realistic and reliable that results can be demonstrated and proven, using an analytical duplication of actual operating conditions.

The prime purpose of Operations Research is to assist the executive in exercising good judgment based on past experience. It cannot replace such men, but greatly improves the decision-making process by providing quantitative information on the probable outcomes of taking any one of a number of possible courses of action. Generally speaking, the purpose of analysis is to maximize the profits of an operation. In every

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instance considerable stress must be placed on measuring the effects of decisions on an overall operation rather than any sub-part or fraction.

In Operations Research, as with most if not all other fields of endeavour, one primary problem in doing good work is the necessity of having good communication. It is absolutely essential that problems be clearly expressed and understood by the people wishing OR assistance. It is impossible to put a hard-headed business man next to a mathematician or physicist and expect any sort of worthwhile liaison to take place. Some means of arriving at a "meeting of the minds" through breadth of knowledge on either or both sides, or use of sound liaison men, is essential. It is not necessary that the detailed methods employed by the specialists be explained to busy executives. However, some means must be found to explain the nature of the approach taken in a convincing manner. A demonstration of such validity is, of course, invaluable. Once a degree of confidence has been built up, then much less attention need be paid to the actual techniques and more emphasis placed on the results obtained.

The question of the type of men required to do "Operations Research" is of interest. In medium or large size companies, it is becoming increasingly evident that a staff of trained specialists can be justified on a continuing basis. However, in the case of a very small company or in the case of a large one just starting out, consultants with experience in this field can be employed profitably. In any event, it is important that Operations Research not be confused with normal statistical analysis or Industrial Engineering, Cost Accounting or other technical and professional approaches. Fundamentally Operations Research is the tool of scientists, generally physicists and mathematicians with a creative and imaginative flare and interest in this field. They must work closely with other specialists and management to do effective work.

In some instances, an Operations Research Team can resolve problems much more quickly and satisfactorily than an individual. Such teams may include not only the mathematical and scientific specialists, who are specifically Operations Research Analysts, but also other specialists from various aspects of the business. This is invaluable, particularly when the operations under study are complex. In any situation, there are known courses of action or "rules of the game" which apply. In developing a true concept or "model" of this operation suitable for analysis, it is vital that the analysis be as close as possible to a realistic reflection of the actual operating methods employed. Large scale problems, particularly in medium and large enterprises, may require processing of huge quantities of data. In such cases, it is some-

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times necessary to employ the use of a computation centre or even to rent or purchase a high speed electronic computer.

The subject of electronic computers or "Giant Brains" as they are sometimes referred to has been overworked in the popular press. Many misconceptions have arisen as to the capabilities and functions of this type of equipment. It is essential to understand that there is nothing mysterious about high speed data processing machines. It is simply capable of adding, subtracting, multiplying and dividing at phenomenal speeds. In addition to the end results, intermediate calculations and instructions can be stored internally in the machine without being printed out or punched onto cards. The electronic or high-speed memory of such equipment is of particular importance in most business applications. We want primarily the best solutions to any given problem and wish the machine to recognize unprofitable or unreasonable answers. The useful answers are printed or punched while others are discarded or put aside.

The machines have absolutely no imagination and cannot exercise anything comparable to judgment apart from following set sequences of instructions or "programmes" under very highly specific conditions. Consequently, whenever a programme is embarked on it is essential that considerable foresight and planning be employed to ensure that the machine will be forewarned and fore-armed against all possible eventualities and can successfully thread its way through the maze of instructions and results up to the final outcome.

Setting up or programming electronic computers is a highly specialized type of work. Today we employ Comptometer and calculator operators without question. In the near future, Electronic Computers and Computation Centres will be equally commonplace. We take for granted the flexibility of punched card accounting systems and many of these are being geared to electronic equipment and greatly speeded up intermediate data processing facilities. Despite the difficulties and time involved in setting up and programming it is true that once a problem has been organized and all the instructions and data are fed to the machines, they are capable of undertaking many man-years of work in a few hours' time. Even at these phenomenal speeds, the accuracy and internal checking features of the equipment virtually eliminate the possibilities of error. Although in some work approximations are sufficient, the equipment is principally designed for, and capable of carrying, almost any degree of significant figures and accuracy which may be required.

Now let us examine some selected case applications of Operations Research which may serve to illustrate what OR has to offer.

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First, let us consider the approach taken to a problem of inventory control in which fluctuations in demand have to be reconciled with the need for a relatively uniform rate of production. In the case in question a central point of supply supported many scattered field warehouses. These warehouses had to provide a large number of customers with prompt and adequate supplies of a large variety of items. In order to provide good customer service most of the field plant operators attempted to maintain inventories at comparatively high levels. This provided some insurance against runouts in stock. Nevertheless, the nature of the field operations and the uncertainties in demand periodically led to difficulties requiring emergency deliveries from the central supply point. Whenever this occurred difficulties arose at the central point since no storage facilities were available to permit immediate shipment of any and all requests. Furthermore, such emergency supplies were generally shipped to the field under very unfavourable transport rates as a result of the small quantities involved. This proved to be a very costly operation.

To these difficulties were added the problems of serious overcrowding resulting from the large "insurance" stocks carried at the many field points. It became increasingly likely that costly extensions to these field warehouses would have to be made if the stocks were to be efficiently warehoused. The problem was to determine whether or not a more profitable operation could be set up and in addition to see if some means could be devised of reducing the warehousemen's responsibilities for making detailed decisions on ordering procedures at many scattered field points. The minimum outlay of capital required to modernize the system was called for. In addition the economics of bulk versus packaged storage of central stocks had to be considered. Questions of eliminating Less than Carload (LCL) in favour of Carload or Truckload rates had to be examined also.

An "Operations Research" approach to the problem required, first a general appraisal of the functions to be performed and methods being employed in relation to the results obtained. Clearly, to have a relatively uniform rate of manufacture on the one hand and a non-uniform rate of withdrawal or sales on the other, requires some form of surge tank or fly-wheel action to permit a build-up of inventories during the low sales periods and a supplementing of production with products taken from inventory during the peak periods of withdrawal. An examination of the existing situation revealed that cushion stocks or insurance supplies constituted the surge tanks and were largely located at the many overcrowded field points.

It can be demonstrated, and intuitively appreciated, that the same degree of protection can be provided in a system through centralizing the majority of the slack at one major supply point. In this way

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numerous duplicate stocks can be combined into a lesser total and owing to the likelihood of peak requirements not occurring simultaneously at all field points for any given product, the total amount of reserve can be substantially lessened. An illustration of this would be the provision of insurance company funds in a central pool rather than at many isolated points. Here too, one is "playing the odds" or being governed by The Laws of Probability in assuming that not everyone's house will burn down at the same time. Consequently, some moderate central coverage can provide adequately for all foreseeable demands at a wide variety of places which would otherwise have to each provide for its worst eventualities.

With these fundamentals in mind a further resolve was made that as much as possible of the decision making process should be made automatic and responsibilities clearly defined. This was particularly desirable in view of the fact that it is not feasible to have a highly trained person controlling stocks at each and every field plant or warehouse.

Furthermore, there is always the difficulty of forecasting demand for a large number of items some of which are seasonal and others of which are apt to have peak requirements occur at any time of the year. This leads to the need for a simple set of control points or guide posts to be provided for each and every product in every individual field warehouse, as well as the central warehouse and bulk storage. These control points were thought of as follows:

1. An "Order Point" to signal any item of stock requiring re-ordering. This was established at a number of units on hand such that, during the delay between ordering and receipt of order, which we defined as the "Order Period", the rate of withdrawal, even under the most severe conditions contemplated, would not result in a runout.
2. The question of how much to order was based on a compromise between ordering too large a quantity, which would result in tying up a considerable amount of working capital in stock, as well as requiring a rather excessive amount of warehouse floor space, versus ordering too frequently, in smaller amounts, but thereby incurring the cost of placing an order and making it up too frequently. It was evident that the excessive carrying charges in the former case could be uneconomic whereas the ordering or preparation costs, which were considered as being relatively fixed no matter what the size of the order, could cause a penalty in the latter. The ideal or optimum quantity to order would represent the most economic lot size or "Order Quantity".
3. The "Danger Point" was conceived of as being below any normally anticipated stock position and was the signal for expediting action in the event that it was ever reached.

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Additional refinement to this ordering procedure resulted from accumulating orders for any given field point, to insure sufficient items being combined in one shipment to provide carload rates. Another refinement was developed for highly seasonal items in that Order Points, Danger Points, and Order Quantities could be established for both peak and slack seasons thereby avoiding the difficulty of carrying, all year round, excessive cushion or insurance stocks on the basis of peak conditions.

The system thus devised assumed that customers' requirements would set the pace for field warehouses, field warehouses would, in turn, set the pace for the central warehouse and it, in turn, would govern the sequence of order filling and operation for the central manufacturing facilities.

This process was termed the Automatic Inventory Control System and the nature of its operation can best be illustrated by reference to the accompanying charts and diagrams. These illustrate the fundamentals of the system outlined above. The mathematics employed in arriving at solutions to economic order quantities and other factors are relatively straightforward.

Based on the foregoing, a model of the operation was developed and a test programme devised. The quantities of data to be processed for test purposes are exceedingly cumbersome and need the scope of a large scale electronic computer. This step, while not essential to the system, has the advantage of providing a simulated operation into which all the rules and control data are fed, in addition to historical records. Thus a "dry run" covering six months' operation can be compressed into less than one day on the computer. From such a test, records of inventory control levels, daily action reports, and complete details on all "binds" and "bottle-necks" including information on delays or waiting lines can be obtained. Once a programme has been devised many additional variations can be tested using forecasted data in place of historical information.

The potential savings resulting from the outline above readily justified the efforts required to develop it and put it into effect.

Another OR case illustration is based on the sale of a specialty product sold through direct channels to professional users, supported by trade paper advertising. In this instance, the executives were interested in knowing whether or not the advertising was justified and just what might be the effects of eliminating promotion of one established item. Sales had been continuing at a uniform rate. When the promotion was eliminated an immediate decline in sales was recorded which continued in a smooth curve which the Operations Research workers, who had been requested to examine the experiment, predicted would continue at a specific rate and would reach a certain level in a specified length of time. The experiment was continued and the actual sales curve almost precisely duplicated the predicted drop in sales. It was noticed by the

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Operations Research workers that the decline in sales followed a mathematical curve similar to that of the decay of a radio-active element. This apparently totally unrelated function suggested that fundamental natural laws were at work following fundamentally parallel principles.

A prediction was made based, on a type of growth curve which is again very common in nature, of the growth of sales with the resumption of advertising, and when the experiment was tried the sales developed almost precisely as predicted. This further served to illustrate how successfully the Analysts had appraised the situation. In the case under consideration the "Operations Research" workers had studied numerous data, formed their basic hypothesis of the behaviour of the sales under given conditions and were then able to test it under actual conditions. This degree of precision can seldom be achieved because of the numerous uncontrolled and unknown variables which enter into most problems. Nevertheless, provided measures can be devised to account for the majority of the variables, many worthwhile improvements can be indicated and occasional major successes achieved.

Another illustration, which may help illustrate an Operations Research approach, has to do with a distribution problem. In this instance, let us consider seven existing supply points in a territory supplying a considerable number of customers. Let us also assume that there are three possible additional locations at which new plants could be established, if it proved desirable. With these ten locations in mind the problem is to determine the most economic possible operation for the overall territory and just what plants should be eliminated or added to meet these optimum conditions. Let us assume that plant operating costs are different at the various points and that the costs of transportation are known to vary with distance. In addition, customer requirements can be indicated and geographically located, the problem then is to find the most profitable course of action — in this instance, the lowest cost method of supplying all the customers in the area from a specific pattern and number of field plants.

A routine manual approach to this problem would be not only ponderous but virtually impossible. To begin with it would be necessary to study one specific case. We might start by assuming that all ten supply points exist and then assign the customers to the ten points so that each customer is supplied at the lowest possible cost having in mind transportation distances and the differences between the operation costs of the various plants. It would then be necessary to add up all the costs of operation in the entire district. The number of calculations involved are considerable and would probably run into many man-weeks of calculations.

The initial case, having ten plants in operation could serve as a basis of comparison for the subsequent cases which would have to be calculated. Although there is only one case involving ten plants there are

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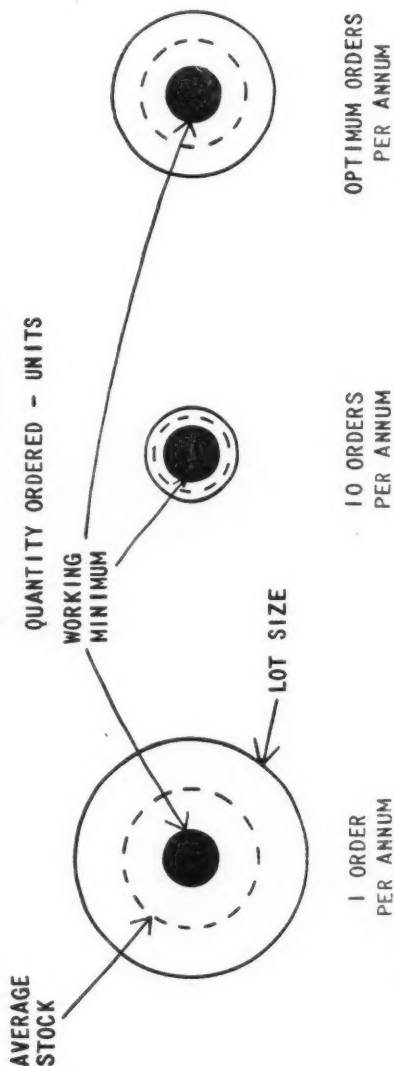
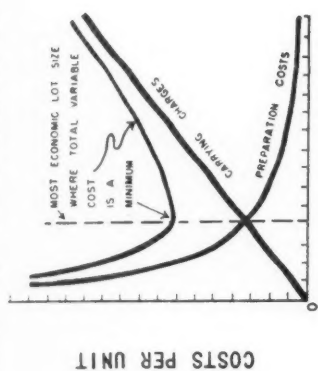
ten possible arrangements involving nine plants in each. For each of these cases the customers would have to be allotted to the most economic supply point and all the costs of operation calculated. In many of the cases, some supply point will be discovered to be inadequate in size to handle the burden of the customers imposed on it. This becomes particularly noticeable as the number of plants is reduced from nine to eight and seven and so on. Whenever a limitation of this sort is reached, it would be necessary to add to the capital cost of the plant, the cost of increased facilities and then the entire operating costs of the plant would have to be recalculated. This, in turn, might cause a re-assignment of customers to another lower cost plant. It may be appreciated readily that the complexities of the problem quickly pyramid and the number of possible alternatives increase until well over a thousand different cases of supplying the customers would have to be considered.

Fortunately, the Operations Research worker has at his disposal one technique among many, which can be applied to the solution of this type of problem. It is one form of what is known as "Mathematical Programming", specifically "Linear Programming". There is nothing basically complicated about this technique. In the first place the word "Linear" means a simple equation, a straight line relationship such as, $A + B = C$. In other words no binomial equations or involved mathematics of higher order are involved. The relationships are all straightforward arithmetic. Secondly, the word "programming" simply means the direction of a sequence of operations. Thus, by Linear Programming is meant the repetitive solution of a number of linear equations. The technique is a means of systematically reducing the mass of solutions, which could be done manually, into an orderly procedure. Once the problem has been set up to be handled by Linear Programming, many short cuts are possible even without the use of a computer.

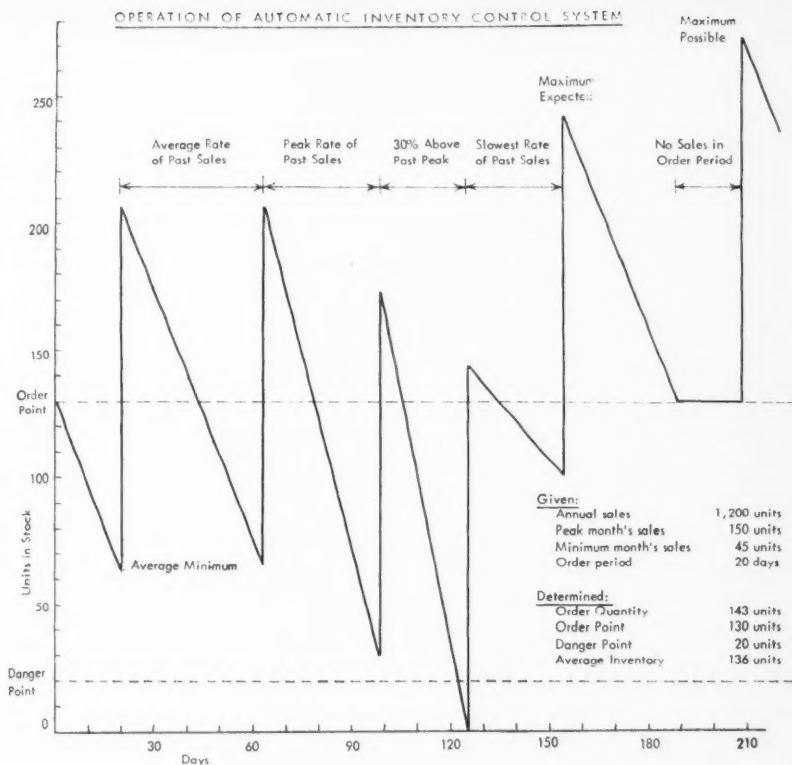
Numerous other Operations Research cases could be reviewed to further illustrate the approach, however, the foregoing few may provide some grasp of what is involved. It should again be stressed that the nature of the approach, rather than the specific techniques employed, is the key to success. The basic thinking and development of a model, and the testing and refinements of such models, using historical data until a predictable basis can be developed for evaluating alternatives, is essential. All the implications, which may have a significant bearing must be taken into account in an overall optimum solution.

Once such a solution and the probable consequences of alternatives have been appraised, it is essential that these findings be reviewed carefully with top policy-making members of management. The success or failure of OR depends not only on technical excellence but on good communication with responsive senior management. The final exercise of judgment and taking of action remains in their hands. Operations Research simply helps define the issues and consequences.

DETERMINATION OF ECONOMIC LOT SIZE



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Financing and Taxation in the Canadian Oil Industry . . .

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In the six years that have passed since oil was found at Leduc and Redwater in Alberta, the oil industry in Canada has grown to considerable proportions. Although the first activity has levelled off somewhat, oil company financing continues to take on increasing importance. The gap between expenditures and product sales in the industry, makes the attraction of new capital imperative. This author discusses some of the problems in financing, handling of investment dollars, and taxation with which the oil industry is faced.

OIL COMPANY financing is a relatively new facet of Canadian industry. Apart from a flurry of speculation engendered some years ago during the development of Alberta's Turner Valley field, the first really major impact was felt during 1948, following close upon the discovery of the Leduc and Redwater fields in Alberta in 1947 and 1948 respectively. Both Canadian and American capital began to pour into oil exploration and development programs in significant amounts. Individuals, partners, syndicates and companies, public and private were in the race to acquire petroleum and natural gas rights. While the tempo of activity has leveled off somewhat, oil industry expenditures in the western provinces are now some \$400,000,000. per year. Product sales are still considerably below that level, with the inevitable result that the gap between expenditures and returns must be financed by the attraction of new capital. Here, the ingenuity and skill of oil operators are as much in evidence as they are in the fields of exploration and exploitation. It is in the best interests of the Canadian oil industry that financing be undertaken on a sound basis, otherwise sources of risk capital will dwindle to the point where growth will be retarded to a dangerous degree. Fortunately, Canadian oil operators generally are fully aware of the situation, and make every effort toward the best use of investment dollars.

Branches or Canadian subsidiaries of American oil companies operating in western Canada are as a rule financed through advances or guarantees from the parent organizations. Most Canadian oil companies however, undertake to raise capital by means of share sales and bond or debenture issues. Public offerings of these securities must conform with the securities acts requirements of the provinces in which the offerings are made. These requirements are in many respects comparable to the high standards established by the United States Securities and Exchange Commission, with which an increasing number of Canadian oil companies have perforce become acquainted. Normally such offerings are underwritten by investment dealers, and as an aid to trading, are frequently listed on one or more of the Canadian stock exchanges, whose operations are conducted on much the same plan as

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American stock exchanges. A number of Canadian oil companies have found it advantageous to be listed on exchanges in both countries.

Public offerings of the smaller companies, customarily involve sale of treasury shares only. In initial offerings particularly, provision is made through securities acts and stock exchange regulations to place in escrow any vendor's or promoter's shares. Prospectus requirements call for considerable information with regard to a company's business history, its management, its financial position, detail of property held, and purposes for which financing is sought. Provision is also made for minimum subscriptions through public offerings, which unless reached, prohibit directors of the vendor companies from allotment and issuance of shares, and enforce the return of moneys subscribed. Few Canadian oil companies have undertaken to raise capital through the issuance of preferred shares, for at this stage of development few have sufficient earnings to warrant payment of preferred dividends.

Companies whose assets include reasonable proportions of proven and semi-proven properties will often arrange for long term borrowings through issuance of bonds or debentures. Many of the recent offerings contain conversion features for the acquisition of treasury shares on a sliding scale basis usually extended over the term of the debt.

In Canada, a company cannot purchase its own shares. Reduction and return of issued share capital may be accomplished only through court order. A company may however issue redeemable preference shares, which can be redeemed out of accumulated profits available as liquid assets. No redemption can be made that would impair the company's capital to the detriment of its creditors and remaining shareholders. Conversely, increase in share capital may be readily effected through provisions made for such action in the various companies acts.

Bank Loans

Bank loans are generally utilized for short term financing. Under normal circumstances these loans must be covered by liquid collateral, such as production assignments, marketable securities, inventories and receivables, etc. Petroleum and natural gas rights may also be acceptable as loan collateral. Until very recently Canadian banks have been precluded by law from making loans on the security of real estate or other immovable property. In arranging for bank loans a company's balance sheet, the reputation and ability of its directors and officers, and its general standing in the community are often quite as important as the collateral offered to secure the loan.

At this juncture it might be of interest to note that the Canadian banking system differs in certain respects from its American counterpart. Canadian banks operate under federal charter and are subject to the provisions of The Bank Act. There are eleven chartered banks and two strictly savings banks in Canada. They alone have the right to call themselves "banks" and enjoy the exclusive right to use the word

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"banking" in connection with their business. They operate collectively some 4,000 branches. Each branch provides means of ready access to the entire facilities of its parent organization.

Fiduciary functions usually involved in financing of any magnitude, cannot by law be undertaken by Canadian banks. Such functions are performed by specially incorporated organizations known as "trust companies". These companies may act as stock transfer agents, registrars, dividend and royalty disbursing agents, escrow trustees, and in any other phase of business involving trusteeships and the administration of trust instruments. Trust companies may also act as administrators under bankruptcy proceedings. They are empowered to negotiate mortgage loans, and may also buy, sell and manage real estate. A number of the trust companies are national in scope, with branches operated in much the same fashion as branches of the chartered banks. Trust companies form an important part of the Canadian business system.

Procedures In the Oil Industry

The oil industry has won wide recognition in the field of finance for the variety of procedures evolved peculiar to the industry, through which capital is raised and risks are spread. Canada is no exception in this respect. Options, joint ventures, farm-outs, working interests, carried interests, dry hole and bottom hole contributions, royalty interests, consolidations and mergers, with all their variations and combinations play their prominent part in the Canadian oil scene. Processes involved in effecting these participations follow closely the American pattern, and require no elaboration here.

A point of difference between Canadian and American practice which might be termed closely related to financing lies in the acquisition of petroleum and natural gas rights. In Canada the majority of these rights are public property in their primary state, under the administrative custody of the provincial authorities concerned.

Exploration rights may be obtained at nominal cost on substantial blocks of undeveloped lands for periods up to five years. However, work obligations and carrying charges on these Crown petroleum and natural gas reservations or permits as they are known, involve heavy capital expenditures. Exploration programs are therefore frequently undertaken on a joint venture basis in order to obtain more extensive coverage by sharing the costs involved in such operations.

Regulations prevailing in most of the western provinces allow reservation and permit holders to convert up to 50% of their holdings to petroleum and natural gas leases in blocks up to nine sections in extent. These are valid for a term of 21 years, and subject to renewal for a like period. Petroleum and natural gas lease rentals are set at \$1.00 per acre per year. The remaining 50% of the reserve areas revert to the provinces as Crown reserves.

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Crown reservations and leases may under certain conditions, often at the request of interested parties, be offered for auction on a sealed bid basis. Accepted bids made in January this year for two reservations in Alberta's new Pembina field, each approximately 92,000 acres in extent, were in excess of \$11,000,000. and \$13,000,000. respectively. A quarter section lease in another "hot" area brought the Crown a bonus of \$760,000. Other quarter section leases on which four wells can be drilled under existing regulations have sold for over \$1,500,000. each. These are top prices of course, with other areas being auctioned bringing in only a dollar or two per acre.

Petroleum and natural gas leases acquired from freehold owners of mineral rights are usually for periods of five to ten years. Acquisition costs involved vary quite as much as costs for Crown rights.

Exploration and development expenditures in western Canada are now at a rate in excess of \$400,000,000. per year. Oil production from some 4,000 wells has yet to reach 300,000 bbls. per day, a figure which it is anticipated will be surpassed this year. Canada's domestic requirements are at present in the order of some 500,000 bbls. per day and will be considerably higher in the near future. Current oil reserves are now approaching the three billion barrel level. Gas reserves have been established in excess of 15 trillion cubic feet. Since 1947, this rapidly growing industry has spent over one and a half billion dollars, against which approximately \$650,000,000. has been recovered through product sales. Financing is therefore still a major factor in Canada's oil and natural gas development program.

Taxation

Today, one of the major expenses of the average Canadian business enterprise is the matter of tax, a position fully shared I am sure, with our American contemporaries. Federal and provincial authorities take a goodly share of the income dollar by way of direct and "hidden" taxes. Included in the "hidden" aspect of federal taxation are sales and excise taxes which now yield approximately \$750,000,000. per year. The sales and excise tax levies are normally included without segregation in the ultimate purchase price of goods, hence the term "hidden". Insofar as the oil industry is concerned, machinery and equipment used exclusively for the production of oil or natural gas are usually not subject to the 10% sales tax and may be imported duty free. Except for the Province of Quebec, the provinces have waived to the federal government their rights to levy income taxes until the year 1957. Provincial levies are usually confined to taxes on property, gasoline and fuel oil, natural resources, amusements, motor vehicle and other licenses, etc. Most provinces also levy a tax on sales to assist in defraying expenses for services such as education and hospitalization.

Under present rates, corporate income is subject to a levy of 18% on the first \$20,000. of taxable income and 47% on the balance, plus 2%

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additional on the whole taxable income levied under the Old Age Security Act, thus making the effective tax rates 20% and 49% respectively. Corporate income taxes account for some \$1,250,000,000. of federal revenue.

Taxable corporate income is defined for tax purposes as the total income from all sources, subject to certain deductions, including business losses which may be carried back for one year and carried forward for five years. Capital profits, and Canadian company dividends are also permissive deductions. In addition, allowances are permitted for depreciation and depletion. Provision may also be made for uncollectable accounts.

Oil companies are by special legislation enabled to deduct exploration and development expenditures up to the amount of otherwise taxable income. These must be utilized to their full extent, but the excess amounts over taxable income may be carried forward without limitation as to time. In other words, exploration and development costs which are deductible and not deducted are not allowed as deductions in future years. These deductions are also available to partnerships and syndicates, but not to individuals.

Expenditures for the drilling of deep test wells may under certain conditions be available for additional allowances by way of tax credits to the extent of 35% of such expenditures, but such deductions are available for use only up to and including the year of final expenditure.

Other Allowances

Depletion may also be claimed by an operator by way of continuing allowance of $33\frac{1}{3}\%$ of the profits reasonably attributable to the operation of an oil or gas well, or the aggregate of all such wells operated, if more than one well is involved. Application of exploration and drilling expenditures to the extent claimed as deductions from taxable income must first be made in determining profits exigible for the $33\frac{1}{3}\%$ allowance. The term operated as used herein, would represent all participants having a working interest in the properties concerned. Holders of royalty interests, or other interests in the proceeds of production sales may claim an allowance of 25% thereof. Shareholders of oil companies are also entitled to deduct from dividend income, an allowance dependent upon certain conditions, of 10%, 15% or 20% of such divided income.

Costs of petroleum and natural gas rights obtained from any government in Canada may be claimed as exploration costs on surrender, if no repayment or other consideration has been made in connection therewith.

Carrying charges to the extent of \$1.00 per acre per year are also permissive deductions.

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Depreciation is allowed on a diminishing balance basis. The annual "capital cost allowance" as it is known is based on the net depreciated value, within the percentage limits established by income tax regulations. Rates for oilfield equipment, contractors equipment, drilling equipment, and automotive equipment are set at 30%; machinery and office equipment 20% aircraft 40%; frame buildings 10%; other buildings 5%. Pipeline rate is 6% unless source of supply is likely to be exhausted within 15 years, in which event the prescribed rate is by special arrangement revised upward as circumstances may require. Provision is made for recapture of depreciation in the event of disposals of equipment at profit.

Generally, expenses deemed not incurred for the purpose of gaining income are not allowable in determining taxable income. Bond discount, provision for income taxes, organization expense, losses on disposal of capital assets (exclusive of depreciable assets) are not allowed as deductions from taxable income. Consolidated returns are not permitted for income tax purposes.

Accounting Practice

It would be a reasonable generalization to state that Canadian accounting practice is very similar to American accounting practice, having regard to the differences encountered by virtue of statutory and tax regulations. This is even more true with respect to the petroleum industry in Canada where for years the preponderance of operations were conducted by organizations with United States origins. Indeed it might be said without flattery that Canada's rapidly growing oil industry owes much of its impetus to American know-how, initiative and risk capital.

Variances in financial statement presentations within the limits prescribed by accounting standards acceptable to both countries, are quite as frequent in Canada as they are in the United States.

There are over 300 companies in western Canada actively engaged in the exploration and exploitation of oil properties. Very few of these companies are integrated, so that the remarks following will not be concerned to any extent with the refining and marketing phases of the business.

Canadian oil company accounting practices indicate some differences which might be of interest to note. Exploration and development costs for instance may encompass all geological and geophysical expenditures plus both tangible and intangible drilling costs, including well casing. These costs may be capitalized or expensed at the discretion of the operator, whether or not production results. Completion costs, exclusive of equipment involved, and carrying charges on undeveloped properties may also be treated in similar fashion.

Provision for depletion of producing leasehold costs and amortization of development costs is frequently made on a "unit of production

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basis", by establishing a factor derived through dividing leasehold and development costs concerned by the estimated recoverable reserves, and applying that factor to the barrels of product sold.

Acquisition costs for unproductive properties are seldom amortized. These costs are normally written off in their entirety on surrender.

Equipment is usually depreciated on a diminishing balance basis to conform with income tax requirements in this respect.

Joint Ventures

Joint venture participation is a major factor in the Canadian oil scene. In joint venture accounting, detail and summary form billings or agreed combinations of the two types, are in quite general use for all phases of operation. Generally, one of the participants in such ventures is named operator, and must account to the non-operators for their participation under the terms and conditions set forth in the accounting procedure determined for the venture. Accounting procedures often follow closely the pattern developed by the Petroleum Accountants Society of Oklahoma. The accounting procedure form published by the Petroleum Accountants Society of Western Canada is with but minor exceptions, identical with the "P.A.S.O." form. Frequent use is also made of the Oklahoma Society's "Material Classification Manual".

Disposition of production inuring to a joint venture is mostly controlled by the operator, who may enter into any term contract for delivery and sale of products from the property concerned. Division orders are accepted by products purchasers, but usually full payment is made to the operator, who in turn remits to the other participants on a net basis after deducting royalties and operating expenses.

It is interesting to note that for tax purposes in Canada there is no difference between the status of operator and non-operator, except that certain tax benefits are not available to individuals who may be participants in a joint venture.

There are to date, no large unitized projects in Canada although a study is now progressing for the unitization of the Redwater Field in Alberta, which contains over 900 productive wells and involves some 27 operators.

Mainly because of the prevalence of joint ventures in Canadian operations, it is hoped that more uniformity in classification of accounts will some day be achieved. The opinion is expressed that the ever increasing encroachment of tax authority and government regulatory requirements may tend to force more and more standards of classification.

Production of crude oil in Alberta is controlled by the Provincial Petroleum and Natural Gas Conservation Board, and is geared by equitable methods of pro-rata to market demand. Production reports must be forwarded to the Board monthly for each productive crown or

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freehold well whether in operation or suspended. Reports are not required on abandoned wells. Rates of daily production are established by the Board and penalties are imposed for infringements. The Board is empowered to shut down production on non-compliance with its regulations. Rates of withdrawal from productive gas fields in Alberta are also established by the Petroleum and Natural Gas Conservation Board. Alberta oil and gas pipelines acting as common carriers are under the control of the Board of Public Utilities. Inter-provincial lines are subject to federal control through the Board of Transport Commissioners. Similar oil and gas production controls prevail in the other western provinces.

Crown royalties for oil and gas must be reported and paid monthly. In the western provinces Crown royalties for oil vary from 5% to 16 $\frac{2}{3}$ %. Crown gas royalties are from 5% to 15% with minimums ranging from $\frac{1}{4}$ c to $\frac{3}{4}$ c per m.c.f. Freehold royalties are usually established at a flat rate of 12 $\frac{1}{2}$ % and are also settled on a monthly basis.

Accounting Methods

Manual, mechanical and electronics methods of accounting are all currently in use by the oil industry in western Canada. The method used is governed largely by the size of the operation involved. Though operations are comparatively small by American standards, practically all phases of oil industry accounting are present. Apart from exploration, development and production accounting with which these remarks have been mostly concerned, we must deal with refining, transportation, marketing and the rapidly developing petro-chemical industry. Each has its own accounting peculiarities and its full quota of rules, regulations and authorities with which the accountant must be concerned. Like his American counterpart, the Canadian oil accountant finds much to fill his day. He is becoming more and more an integral and important part of the management team.

The problems, procedures and aspirations of the Canadian oil industry do not materially differ from those of the United States. The hope is expressed that we may develop in increasing measure, an exchange of knowledge, skills and personnel to the mutual benefit of our respective petroleum communities.

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Cost Reduction in the Limelight . . .

By G. MOLLER, D.Jur., C.A., R.I.A.,
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Cost analysis, control and reduction have become vitally important subjects in these days of narrowing profit margins. Cost and Management has presented several articles on these subjects in recent issues. Here Mr. Moller reviews current thought on the subject and comes up with some valuable information, which will be of special interest to controllers and other financial executives.

NOT LONG ago, I saw on "The Late Show" on T-V, a movie called "High Conquest". This was a story of the climbing of the Matterhorn in Switzerland. In this moving picture, an old Englishman asked the question: "What makes men climb mountains?" The answer was: "Mountain-climbing does not need any justification." It is the challenge of the seemingly unconquerable which leads us on, and those who stay in the valleys all the time will never know the meaning of "High Conquest".

When we thought that everything was booming and the profit and loss statements made us feel right on the peak of the world, we were actually walking very comfortably on the bottom of a valley, on a dead-end street.

Now, we are quick on the climb. We have not even come near the peaks yet, but we start to see a bit more of the world around us and we become aware again that one has to bend all his efforts continually if one wants to stay ahead of the game.

It is not surprising that the quest for cost reduction is very much in the limelight.

Cost Control

Cost control is a necessary prerequisite for cost reduction. I have undertaken to review the most recent developments in cost reduction, although the Bible says: "A prophet is not without honour, save in his own country, and in his own house."

Cost Accounting, like scientific Management, has its cradle in manufacturing operations. Naturally, all the techniques we are familiar with have been developed against the background of the operating plant. The reduction of direct costs and particularly of direct labour expense have been given most of the cost accountants' and industrial engineers' attention for several decades. Nobody should scoff at the possibility of cost reductions in direct labour; we did not stop trying to improve the automobile as soon as the flying machine was perfected. Nevertheless, it can safely be expected that the overwhelming progress we look forward to will be in the field of the aeroplane, rather than in the development of the automobile, even although there are many more automobiles on the road than aeroplanes in the air.

Time measurement has been further developed in the past decade through the means of M.T.M. doing away with the tedious and con-

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tentious stop-watch. There can be no doubt that M.T.M. studies have helped us in many plants to reduce the direct labour, not merely by establishing more justified and lower standards for any one operation, but mainly by applying the time measurement tables to the technique of deciding the most efficient method in any one production process with a given machine or tool. The literature on M.T.M. is mounting and for those who may not be familiar with the writings on this subject, I will quote

Maynard, Stegmerten & Schwab, "*Methods-Time-Measurement*" McGraw-Hill Book Company, 1948.

"*MTM. The Journal of Methods-Time-Measurement*" The M.T.M. Association, Ann Arbor, Michigan.

Ronald St. Martin, "*Predetermined Time and Motion Methods*" A.M.A. Manufacturing Series, Number 211.

In a recent article¹, the author asks the question: "What is new about controlling costs?" He states that effective cost control must be routed into close co-operative relationship between the Cost Accountant and every other member of the management team.

"Penny-pinching economy at the expense of long-range progress is not a worthy cost control philosophy today."

Moore sees a main task for cost control in determining the cost effects of such management level problems as poor organization, badly defined or poorly distributed work responsibility or short-sighted personnel policies. He demands a considerably broader approach than we have had in the past by acknowledging the advisability of spending money to save money: e.g., investment in new machinery and equipment, mechanization of office work, statistical quality control, profit analysis and capacity studies.

The American Management Association had four papers presented at the Manufacturing Conference held at the Hotel Statler, Cleveland, April 26-28, 1954, under the main title "Strategic Areas in Cost Reduction"². The titles of the papers presented indicate the areas in which cost reduction seems most desirable and obtainable.

"*Purchasing for Profit*" by Stuart F. Heinritz, Editor of Purchasing magazine, stresses that between 35c and 75c of every dollar of sales represents material cost and the "average" manufacturer shows up at 55.4c of the total sales dollar. The author claims that

"The true measure of value in buying is how effectively and economically a material or product serves the purpose for which it is purchased.

"Overspecification represents sheer waste; it is one of the most prolific sources of hidden, unnecessary cost."

1—Martin A. Moore, "The Growing Responsibilities of the Industrial Accountants", N.A.C.A. Bulletin, August 1954, Section 1, page 1564.

2—A.M.A., Manufacturing Series, Number 215.

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Heinritz sees the basic competition between materials and products rather than between producers and feels that the purchasing department is the logical focal point and channel for information on improvements of old materials and new materials being developed to compete with existing ones. Arriving at proper decisions on the question of "buy or make" may lead to cost reduction but there are further ways in which purchasing can influence even the supplier by "purchase analysis". Quite recently, the Wall Street Journal brought a front line article under the heading "*The Purchasing Agent Dons Scientist's Cloak at More Big Firms*", which stresses the increasing importance of purchasing research or, as Heinritz calls it, "purchase analysis". Properly defining the procurement cycle and making use of shorter lead times can be cost-reducing but, on the other hand, an excessively high turnover of materials can be as wasteful and costly as slow-moving stock. To find the golden middle line is the purchasing division's main responsibility.

The next paper deals with "*Slicing Waste Effort From Materials Handling*". Improvement of material handling within the plant by automation or study and particularly improved scheduling seems to hide a large potential cost reduction possibility.

George J. Martin dealt with "*Increased Efficiency Through Preventive Maintenance*". He distinguishes between "breakdown maintenance" and "preventive maintenance". Preventive maintenance must be planned. In order to plan it, the enterprise needs:

"Equipment records, preventive maintenance inspection forms, work orders, maintenance time cards, storeroom withdrawal orders, monthly reports of preventive maintenance inspections, and mechanical down time reports."

Martin lists the following advantages and benefits of a sound preventive program:

1. Reduction in emergency breakdowns during scheduled production periods.
2. Reduction in cost of maintenance, labour cost, and overtime.
3. Reduction in cost of maintenance parts and supplies.
4. Installation of realistic equipment replacement schedules.
5. Reduction in maintenance job costs.
6. Better work control through planning and scheduling.
7. Economical use of maintenance personnel.
8. Complete knowledge of job costs and routine maintenance expenditures."

In the closing paper presented by Warren C. MacFarlane, President and General Manager, Minneapolis-Moline Company, Minneapolis, "*Top Management Views Cost-Cutting Controls*", the author admits that "there is no formula or recipe for cost control". He considers it "a tightening-up process". He advocates minimizing the paperwork load but warns that elimination of reports may have just the contrary effect

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if undertaken indiscriminately. Product standardization and interchangeability promise substantial cost reduction. Better quality control is also one of the items which have become very important. MacFarlane stresses that the goods cannot only be produced properly but they have to reach the customer in a satisfactory condition. Better housekeeping is one of the possibilities in saving. He claims that waste "in whatever amounts is criminal in free enterprise because it may so endanger us as to bring statism with all its open and hidden evils."

Literature

It becomes increasingly difficult to keep ahead of the flood of literature on the subject which justifies reviews like this one.

Curtailement vs. Reduction

L. L. Farrar, Price, Waterhouse and Company, New York, tries to make a fine distinction between³ curtailement and reduction of costs. The first one "implies the elimination of both the cost and the essential source", for instance, the elimination of an advertising appropriation, whereas the reduction means "the obtaining of essential services at a lower cost". Curtailement of expenses usually carried out by "across the board" cuts generally works like a hatchet, particularly on those departments which have been more efficient before the curtailement than others because of the failure to take into consideration variation between benefits received and costs to perform. In the author's opinion

"The most practical method for controlling expenses and costs — which also means being in a position to justify costs — is through work measurement and a related supervisory training program."

"The primary purpose of a work measuring program is to:

1. Permit implementation of the decision at a minimum cost;
2. Establish a procedure for determining costs;
3. Evaluate costs in relation to benefits actually realized."

Outlying Areas of Cost Reduction

At this point, it may be well to realize that the chances of a worthwhile presentation can only be enhanced when we narrow the field of our review to certain specific areas of cost reduction. It may be more profitable to devote our time to the field of inventory costs, distribution (marketing, selling) costs, and administrative (clerical) costs.

Inventories

Inventory control is in the limelight because of the change from a sellers' to a buyers' market which has profoundly affected the procurement policies of most of the Canadian enterprises. The purchasing agent who can boast of a big inventory which provides now for all

3—L. L. Farrar, "A Method of Approach to Curtailement and Control of Costs" *Controllershship: Trends and Techniques*. Controllers Institute of America, 1953, page 94.

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contingencies in the production program is not any more the right man for the job. If one accepts the idea that the rate of return on investment is the guide to management decisions^{4 5} then the relative size of the inventory carried by the company has a decisive influence on the return on investment performance of the company. In an article of recent vintage⁶, the authors suggest five kinds of inventory analyses leading to control of that asset:

- “1. Activity analysis.
2. Work in Process analysis.
3. Economic lot quantity analysis.
4. Production and inventory control systems analysis.
5. Quantitative analysis.”

There is no question that the Controller and the Accountant working for him can play a great role in controlling inventory size. The co-ordination of capacity, production methods, and production rates with inventory size is a management problem of the first order. The analysis of these problems must be based on accounting information. The relation of the costs of carrying inventories to the problem of losses in sales from being unable to service customers promptly, has to be studied and the authors mention operations research in this connection.

I am inclined to agree with the authors that most of the information could and perhaps should, from the viewpoint of efficiency, come from the controller's division or at least be co-ordinated by this group.

The 1954 Conference of the National Association of Cost Accountants dealt also with “Inventory Control and Valuation”⁷. The discussion produced among other statements the interesting point that management should be less concerned with the size of inventory than with the amount of obsolete items it contains.

“It is possible to have an overall high turnover which is concealing small portions of slow moving or obsolete items.”

The problem of forecasting seasonal sales for inventory control purposes was also discussed.

Before leaving inventory control and reduction, I would like to mention one point which has been driven home in the company I am serving as Controller. In the period of scarcity over the last 12 years, steel was on a strict allocation and this allocation again was on a quarterly basis. This meant that orders were given by quarters and even our inventory records were kept on separate cards for each quarter. Timing of delivery was beyond control of the buyer. The Purchasing Agent who failed to order his full quota, for instance, in

4—R. B. Read, “Return on Investment — Guide to Decisions”, N.A.C.A. Bulletin, June 1954, Section 1, page 1231.

5—Thomas H. Casson, “Return on Investment”, The Controller, September 1954, page 411.

6—John H. Kempster and W. Van Alan Clark, “Avenues for Inventory Control Analysis”, N.A.C.A. Bulletin, July 1954, Section 1, page 1406.

7—1954 Conference Proceedings — 3, N.A.C.A. Bulletin, September 1954, Section 3, page 174.

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the winter quarter where production traditionally fell to a serious low would probably have lost his job. Now, a full turnabout in this procurement policy has to be made and we are in the process of determining minimum and maximum inventories by each kind and size of material not for a year-round application, but by season and we have little doubt that this determination will be kept on a very flexible basis, scheduling deliveries to even shorter periods than half month, which we now attempt to do; matching these deliveries with the requirements of production and tremendously shortened delivery terms for the finished product. I suspect that this general change in procurement approach will affect a good many enterprises.

It will be the controller's task to probe into the minimum and maximum quantities determined by the purchasing agent, preferably in co-operation with the executives in charge of production and sales with a very critical eye for seasonal and market trend fluctuations.

Marketing Costs

Cost control for marketing operations has been featured by excellent Research Series of the National Association of Cost Accountants⁸.

May I quote from one paragraph on cost control in the first mentioned publication:

"The cost control function comprises setting goals in terms of costs, accumulation of current costs, and reporting comparisons. Foremost among the comparisons used is that between planned and experienced costs but others such as territorial, product line, operating division or individual salesmen comparisons are also used to facilitate such control. With order-getting costs, the budget is the principal accounting tool for establishing control before the fact. Current cost comparisons then serve to tell management whether or not the money is being spent according to the plan laid down by the budget."

Order-Getting Costs

The study drives the point home that advertising, sales promotion and field selling expenses are not caused by the billed sales of the period but, on the contrary, are expended in order to create the billed sales of a following period. This makes a big difference because we are, as cost accountants, accustomed to consider the costs as caused by the operation instead of considering certain costs as the cause for the operation. This aspect determines the attitude to any cost reduction in these fields as it becomes pretty obvious that any reduction of order-getting costs could lead to a reduction in sales and thereby to a shrinkage in the operations of the company. Actually, one could be led to

⁸—Research Series No. 26, Cost Control for Marketing Operations — Order Getting" — June 1954, Section 3 and Research Series No. 27, "Cost Control for Marketing Operations — Order Filling", August 1954, Section 3.

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believe that the depression of the early 30's was perhaps at least partially caused by the reductions in order-getting costs as part of a cost slashing program without regard for the inevitable consequences of such folly. The study says that

"In departments other than Advertising and Sales Promotion, executives and supervisors are encouraged to spend less than the budget allows and they may divert a specific allowance to another purpose."

This attitude would be entirely wrong with regard to advertising and sales promotion costs.

In a rather belated recognition of this fact, the sales incentive bonus plan in our Company is now being changed by eliminating the provision under which a District Office which reached its quota would be bonused for any savings in sales expenses against the budget for these costs to the tune of one-half of the savings. In future, we will not encourage savings in these categories which were only a reasonable goal in times of marked material scarcity and thereby restricted sales possibilities.

Order Filling

This brings us to the field of order filling. Following the aforementioned Research Series No. 27, "Cost Control for Marketing Operations — Order Filling", we observe that order filling costs, contrary to order getting costs, tend to vary in total amount with sales orders or shipments. As physical handling of goods and repetitive clerical operations predominate in most order filling activities, physical standards, expressed in man hours and more physical units, can be established as a basis for cost control. This feature is often recognized by having Warehousing and Shipping report to the executive in charge of production, particularly when these operations are located in the factory. This sometimes tends to disguise the fact that warehousing and shipping are marketing operations and these costs are marketing costs.

"The flexible budget is the principal accounting tool employed for controlling order filling costs."

But it should be realized that these percentages of sales as a measuring stick have distinct limitations. Short term changes in sales volume will naturally influence the ratio decidedly if we look at total costs instead of looking at variable costs only, but even variables are sometimes depending on other factors than sales volume. As an illustration, I would only like to quote the decrease in prices which, even with the physical volume of goods moved being unchanged, will bring about an unfavourable variation in the variable cost ratio expressed in dollars.

It has been acknowledged that cost control cannot be as extensively applied to marketing operations, which must be performed outside the company's plant or warehouse, than to those performed inside. The

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organization plan and the chart of accounts, following the organization plan, may have a distinct influence on the recognition of order filling costs as such and therefore on different standards in different but otherwise comparable enterprises.

The lack of detailed knowledge of order filling costs is apparently the main cause for lack of adequate cost control in this field.

I have little doubt that more attention will be given in the near future to ascertaining details in that respect by providing:

1. Analyses of sales and shipments, i.e., what goes where.
2. Analyses of movements by products.
3. Cost data to support attempts to get rate adjustments."

For measuring purposes, current actual transportation costs are compared with one or more of the following current figures:

1. Costs incurred in prior periods.
2. Costs incurred for other similar units of equipment and in other geographical areas.
3. Budgeted or standard costs.
4. Rates at which the same service could be purchased.

Comparisons between current and prior period costs are made by all of the companies interviewed. Such comparisons are reduced to a unit basis (e.g. per hundredweight of goods shipped or per sales dollar) to avoid differences in totals due to differing volumes of goods transported."

Cost control, through comparison with purchased transportation, is of course only possible if your own transportation costs are exactly ascertainable and properly allocated to the merchandise the transportation costs of which you wish to compare.

The area of control of sales deductions leads automatically into the large field of quality control. Sales deductions (returns and allowances) have their reasons mostly in lack of quality, either in production, shipping or sales (incorrect order processing or lack of understanding with the customer). Sales deductions can be controlled either by budgets, where the deductions as such are budgeted, or by detailed analysis of sales returns and allowances by reasons, products and sales districts. In our Company, we have resorted to complaint reports from the field as a means of control of this expense because sales deductions always represent an expense — in the best case, consisting of the cost of handling the returned merchandise — in the worst case, in the costs of the products shipped, the freight in and out if the material being made to order has to be scrapped.

I would be remiss in not mentioning a recent article, "How to Reduce Selling Costs Without Scuttling Your Sales Program"⁹. This article claims that many manufacturers do not attack waste in their marketing

⁹—Steel The Weekly Magazine of Metalworking August 16, 1954.

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activities because it's so hard to get at the facts for sales costs. The cost of the average industrial salesman's call is amounting in the States to \$17.24 and the cost of getting an order to \$187.39. The cost of keeping a salesman in the field has increased more than 25% since 1950. All these figures only emphasize the necessity for controlling these costs more efficiently than heretofore. Following this article, this can be done by setting objectives and policies or, otherwise expressed, by planning sales scientifically.

Time studies for salesmen are recommended. It also pays to ask yourself the question: "Will increasing sales expenditures pay off?" In this connection, a case study by the Research Institute of America is presented in the article which leads to interesting conclusions.

In our own company, we have resorted most recently to requesting our salesmen to send us their itinerary for the coming week beforehand which induces them forcefully to plan their calls and avoid time-wasting effort. The actual call reports can then be compared with the itinerary and may serve as a basis for sales costs and, particularly, traveling costs examination. All these are most recent and are only exploratory steps in a rather unexplored field of increasing interest and importance.

Administrative Costs — (Clerical)

We should take a hard look at cost reduction possibilities in the administrative field. The controller usually has direct responsibility for a large part, if not most, of the administrative services supplied in a company. It is an acknowledged fact that scientific management for a long time did not penetrate the office in the true sense of the word.

The call for standards for clerical performance was made very forcefully by Paul B. Mulligan and hasn't lost its urgency yet¹⁰.

It is high time that controllers make a systematic effort in attacking office inefficiency. The thing we lack most in an office are reasonable standards of performance, particularly of repetitive clerical work. An article in the September 1954 issue of the *Management Review*¹¹ states in this connection:

"We have hardly begun to take advantage of established and accepted mechanical and electrical engineering practices long in use in the plant."

The author acknowledges that there is no "quick and dirty solution" but offers a few practical suggestions:

- "1. Secure approval of a budget equal to at least 5 to 10 per cent of your payroll for mechanization development projects.

10—Paul B. Mulligan, "Standard Time Data for Clerical Performance Standards", *The Controller*, April 1952, page 165.

11—R. L. Harrell, "Mechanized Productivity in the Office: How Far Ahead?" *The Management Review* (A.N.A.), September 1954, page 588.

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2. Contact nearby machine shops, die makers, and cabinet-makers. Develop their interest in helping you to work out your problems. They will probably be able to call on someone with designing ability to assist.
3. Borrow an engineer from your engineering department for a period long enough for him to learn of your problems, for the development of solutions, and for installation and follow-up in making any new developments work.
4. Retain an experienced engineering firm to work with you on analysis and design problems.

If your problem is of sufficient magnitude, you should consider hiring: (1) an experienced engineer with a background of mechanical design and perhaps a bit of electrical experience, coupled with exposure to industrial engineering in the office area — in short, an office engineer; (2) an experienced industrial engineer with a record of unique accomplishment in the office area; or (3) a young engineering graduate with mechanical or electrical training, and an aptitude for analytical design."

In another article in the same magazine¹², the writer offers the opinion that developments in office machinery, particularly in electronics, will play an increasingly important part in the life of office managers. The implications will be wide-spread, having a bearing not only on production, but upon the organization structure, job training, and employee morale. The author believes that —

"Our management will become aware of the wisdom of providing adequate staff facilities — research talent and technicians — to help promote more effective office administration through advice and assistance to operating supervisors."

Electronics

Two articles in recent issues of *The Controller*, deal also with the revolutionary developments brought about by the electronics appearing on the horizon for office services.

The July 1954 issue of *The Controller* brought a most interesting article on this subject¹³ which I recommend strongly to those who have skipped it under the daily pressure, perhaps because they felt that electronics are still far away from their offices in view of the size of the company or office operations. The author develops an interesting theory which makes the article most challenging even for those who do not see electronics in their offices within the next five years.

12—Frank L. Howland, "Progress in Office Management: Yesterday, Today, Tomorrow" — *The Management Review* — A.M.A., September 1954, page 583.

13—William B. Hanton, "Electronics Thinking and Clerical Costs" — *The Controller*, July 1954, page 318.

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"The habit of electronics thinking can be adopted today even though the equipment may not be applicable to medium and smaller offices for some time to come. Not only will this prepare for eventual utilization of electronics, it will — today — reduce costs of performing clerical operations."

Hanson claims that

"Only fundamental analysis of clerical problems will restore the balance between clerical and production forces and more nearly equalize the demand for clerical workers with the recruits available."

In his opinion, the solving of the clerical cost problem has two phases:

1. Recognition of clerical activities as instruments of management control — their objective being to provide information for the guidance of management.
2. Acceptance of clerical functions as services which should not be limited by the confines of departments, groups, or divisions of a company. Clerical activities and duties are generally inter-departmental in nature.

... Management that considers clerical activities as instruments of management control and views the clerical functions as unbounded by the confines of organizational components has a start toward cutting clerical costs. Companies which have accepted these concepts are realizing substantial economies and bettering their competitive position."

In the August 1954 issue of *The Controller*, Paul Kircher¹⁴ deals with the preparatory steps which we should take in the direction of the use of the new equipment and techniques. If we want to use the new machines efficiently and successfully, it will be necessary, in the author's opinion, to form a team consisting of mathematician, engineer and accountant. Kircher claims that most businesses "have never surveyed their data needs as a whole, in terms of quantities and qualities."

"A carefully prepared manual, developed by a competent systems and procedures department, will serve as a good starting point."

Saving the labour of from 50 to 100 clerical workers will pay for a large-scale computer system. A major item is the cost of making the studies and the actual changeover for which staff must be early trained, duties re-assigned, new procedures devised, etc. Kircher expects from the new equipment the development of new and much more effective controls of performance than we have hitherto been able to achieve.

¹⁴—Paul Kircher, "The Gap Between the Electronics Engineer and the Accountant", *The Controller*, August 1954, page 358.

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"There are three phases to this problem of control. The first is the establishment of norms or standards and of allowable deviations from those standards. The second is the reporting of actuals and comparison with standards. The third is analysis of significant items for executive action."

Among the results expected from the computer are:

"Improved sales forecast,
Estimates for rapid bids on contracts,
Systematic production scheduling,
Inventory control."

In Kircher's opinion, the controller has the ultimate responsibility for leading his company into this new field of electronics and should work towards the closing of the gap between the engineers and his accountants.

Operations Research

This article brings us logically to the field of linear programming and operations research.

Although I have encountered an article in the Harvard Business Review¹⁵ before, my first real acquaintance with operations research came from the Cost and Management Conference which took place at the beginning of July this year at Bigwin Inn. One entire afternoon was devoted to this new chapter in management problem solving. Professor Richard M. Cyert (Carnegie Institute of Technology in Pittsburgh, Pa.) gave the introductory talk on the role of operations research as an objective scientific approach designed to aid management in evaluating alternatives and Mr. P. J. Robinson (Co-ordinator, Marketing Research, Imperial Oil Limited, Toronto) spoke about the scope and selected applications of operations research.

It will suffice here to quote the following definition of operations research¹⁶

"Operations Research is the organized application of the methods and techniques of science, particularly the physical sciences, to the study of operating problems in business, government, or the military. The objective of this work is to gain an explicit quantitative understanding of the essential elements of an operation and the factors affecting results, in order to give management a sounder basis for decisions.

Operations research is an experimental field. Its goal is to provide quantitative theories describing operations, which will stand up under experimental check."

15—Alexander Henderson and Robert Schlaifer, "Mathematical Programming — Better Information for Better Decision Making" — Harvard Business Review, May-June 1954.

16—John F. Magee, "Enter-Operations Research" — N.A.C.A. Bulletin, June 1954, Sec. 1, p. 1252.

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It should be stressed here that operations research does not take the decision-making function away from management but merely endeavours to assist the executive in making his decision wisely.

"The basic purpose of an operations research team is learning the fundamental characteristics of business operations to see whether, and to what degree, operating methods can be modified within the existing characteristic framework and what types of modifications may be worth while."

The author stresses the necessity of the closest co-operation between the operations research team and the accounting groups.

Operations research opens up vistas of scientific decision-making in the fields of inventory control, scheduling theory, and even in the field of consumer and sales behaviour, every one of which should lead decidedly to cost reduction. How far away we are from widespread application of these new and exciting tools for management is everybody's guess and will, to some degree, depend on our own capacity for absorbing and digesting new avenues of approach which had not even been dreamed of when we started our way to controllership.

FOR FURTHER READING

PROFIT ASSURANCE THROUGH COST REDUCTION — A. A. Kasper, *Cost & Management*, Sept. 1954.

COST REDUCTION — Prescription for Tomorrow's Profits — A. M. Hartogensis, *N.A.C.A. Bulletin*, Jan. 1953.

A COST REDUCTION PROGRAMME — P. W. Hoge, *American Management Association, Manufacturing Series No. 209*.

ORGANIZED COST REDUCTION — R. E. Burton, *American Management Association, Office Management Series No. 133*.

COST REDUCTION TO HELP SMALL BUSINESSES — W. B. Edgar, *N.A.C.A. Bulletin*, March 1954.

Student Section . . .

FUNDAMENTALS OF COST ACCOUNTING — 1954

QUESTION 1 (18 marks)

The production department and general accounting department of XL Manufacturing Co. Ltd. have submitted the following comparative figures in respect to the company's operations:

	Six Months Ended 31st Dec. 1952	Six Months Ended 31st Dec. 1953
Production Costs:		
Direct Materials	\$ 56,225.00	\$ 76,500.00
Direct Labour	112,500.00	82,000.00
Factory Overhead	28,125.00	33,500.00
Sales Value of Production	225,000.00	281,000.00

The production manager reported that new equipment had been installed prior to the second six month period with the result that the production was substantially increased over that of the first six month period.

You are required to prepare a memorandum for submission to the management, analyzing the production of the two periods and submitting such comments as you consider necessary in the circumstances. Calculations may be made to the nearest full percentage.

SOLUTION — See next page.

COMMENTS

A. V. HARRIS, C.A., R.I.A.

This question was intended to be a test of the student's ability to write a logical story for consideration of a senior group. The forms of presentation were many and the examiner suspected they were not the type of work which would be submitted under actual business conditions. Many did not attempt to relate costs by elements to total costs, and therefore did not see the significant changes.

Marks on the whole were poor; about two-thirds of the papers submitted not receiving a pass mark on this question.

SOLUTION TO QUESTION 1

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Memorandum to Management Committee:

There follows a summary of the operations of XL Manufacturing Co. Ltd. for the six months ended 31st December, 1952 and 1953:

	Six Months Ended December 31st, 1952			Six Months Ended December 31st, 1953		
	Amount	Percentage of Production Costs	Percentage of Sales Value	Amount	Percentage of Production Costs	Percentage of Sales Value
Value at Sales price of finished production	\$225,000.00	—	100.00	\$281,000.00	—	100.00
Production Costs:						
Direct materials used	56,225.00	29	25.0	76,500.00	40	27
Direct labour	112,500.00	57	50.0	82,000.00	43	29
Factory Overhead	28,125.00	14	12.5	33,500.00	17	12
	<u>\$196,850.00</u>	<u>100</u>	<u>87.5</u>	<u>\$192,000.00</u>	<u>100</u>	<u>68</u>
Indicated Gross profit	<u>28,150.00</u>		<u>12.5</u>	<u>89,000.00</u>		<u>32</u>

As indicated from this summary, the indicated gross profit has increased from \$28,150.00 in the first six month period to \$89,000.00 in the second six month period, a net increase of \$60,850.00. This increase resulted from an increase of \$56,000.00 in the sales value of finished products produced, plus a decrease of \$4,850.00 in production costs.

The comparison of factory overhead in the two six month periods is:

Six months ended 31st December, 1952	
Factory Overhead	28,125
Direct Labour	= 112,500 =
	25%
Six months ended 31st December, 1953	
Factory Overhead	33,500
Direct Labour	= 82,000 =
	40.8%

The increase from 25% to approximately 41% in the ratio of factory overhead to direct labour resulted principally from a decrease in direct labour expended and to a minor extent from an increase of \$5,375.00 in the overhead costs. The direct labour cost reduction reflects the production changes through the installation of new equipment.

By the changes, the production costs decreased from 87.5% of sales value of finished products in the first six month period in 1952 to 68% for the corresponding period in 1953.

in 1952 to 68% for the corresponding period in 1953.